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(54) Telescopic jib cranes

(57) A crane has a chassis 18 and a telescopic jib having a lowest telescopic section 1 pivoted to the chassis and movable in a vertical plane by one or more luffing rams 19. Extending perpendicularly from the section 1 is a frame 5 braced by cabling connecting the frame to the foot end of the jib, and connected by cabling 9 with an extensible telescopic section. A counterweight 22 is supported on a mast 21, the inclination of which is adjustable by winch 24 either to maintain the counterweight at a fixed position relative to the chassis or to vary the position of the counterweight so as to vary the moment imparted by the counterweight to compensate for changes in moment as the jib is raised or lowered.

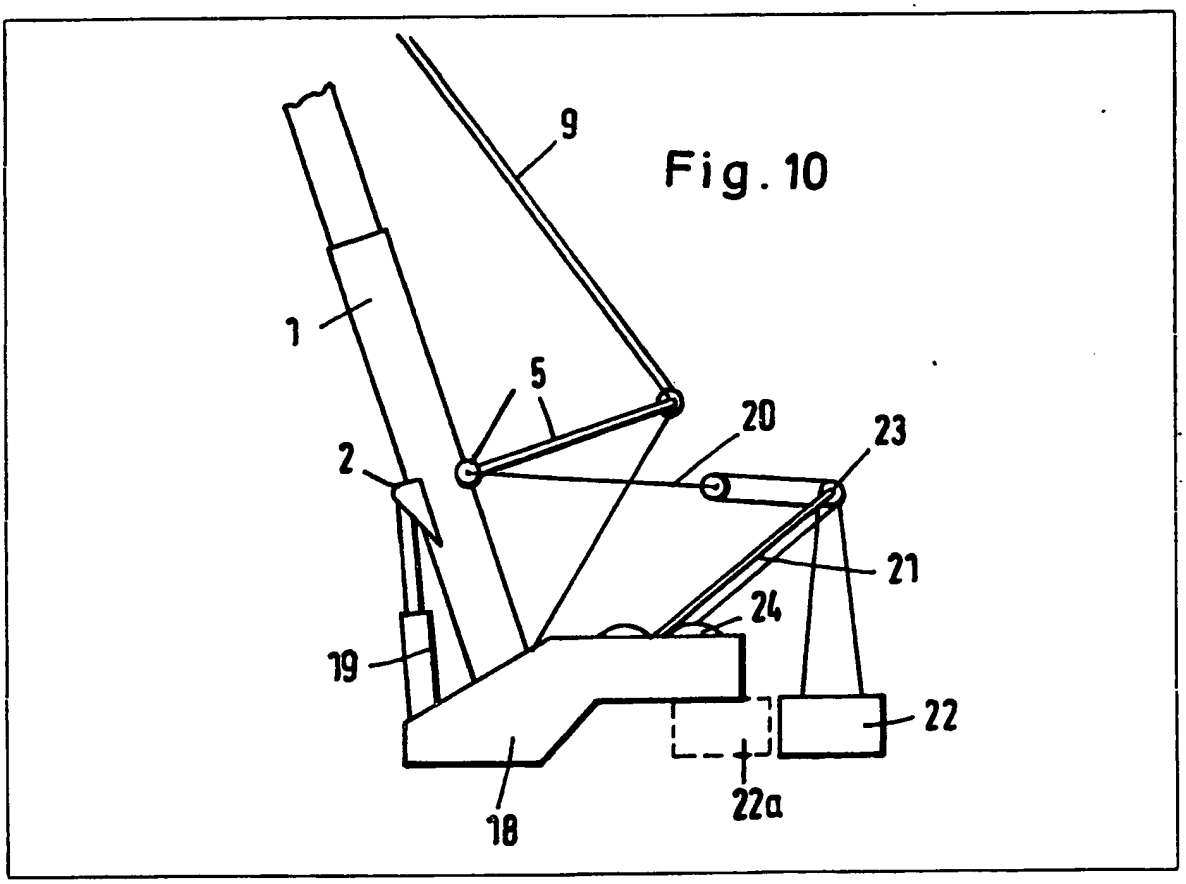

Fig. 10

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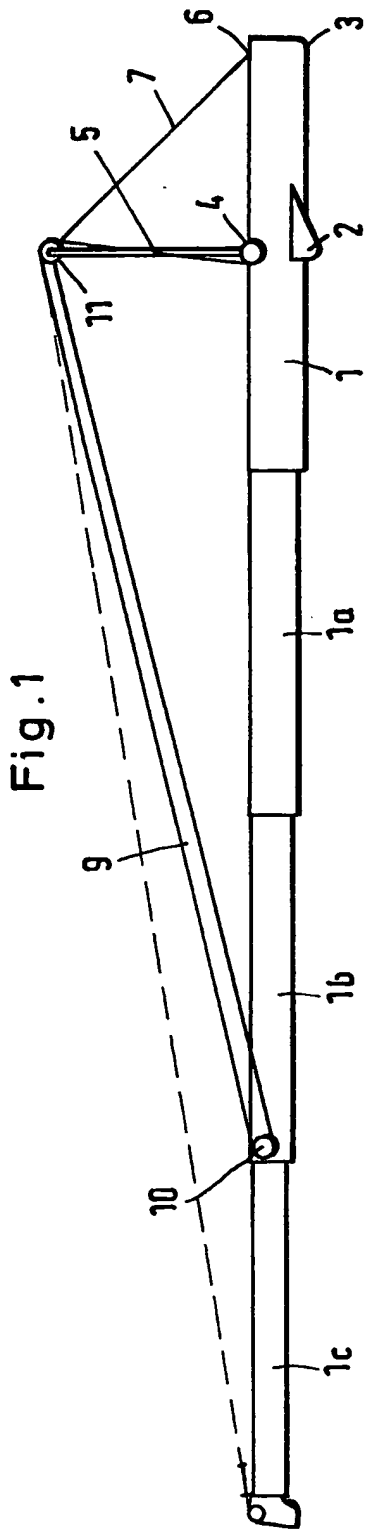

Fig.1

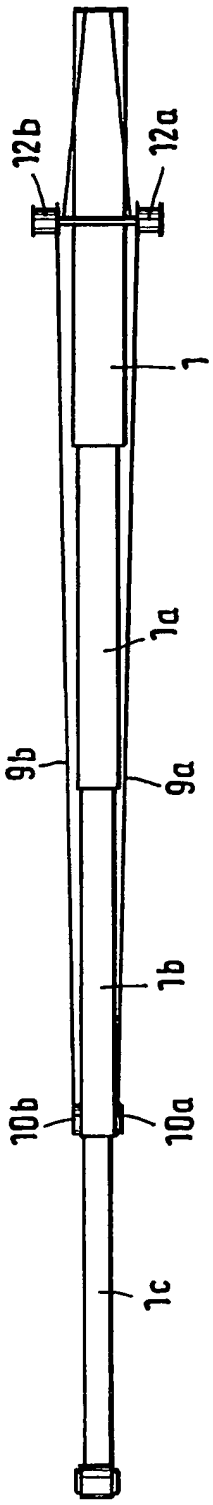

Fig.2

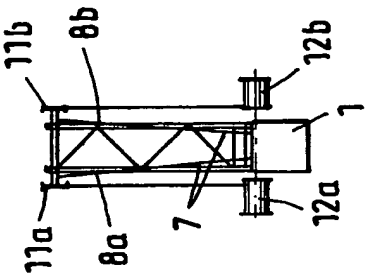

Fig.3

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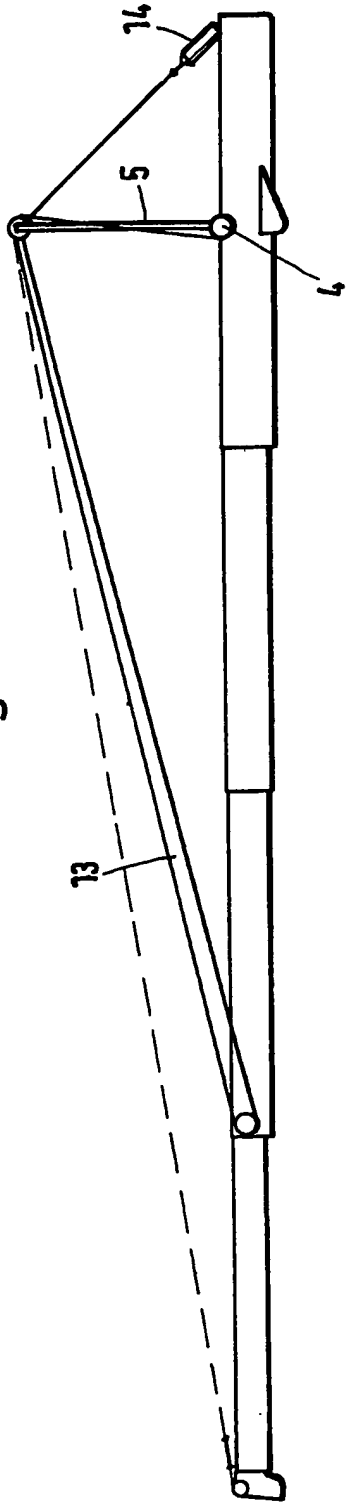

Fig.4

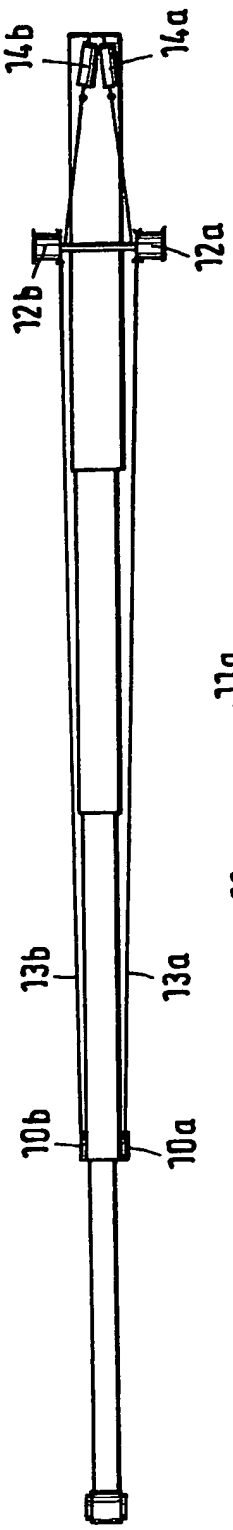

Fig.5

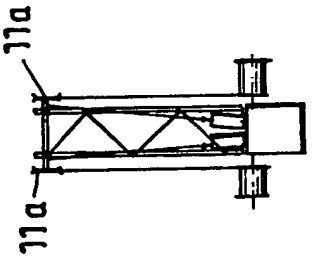

Fig.6

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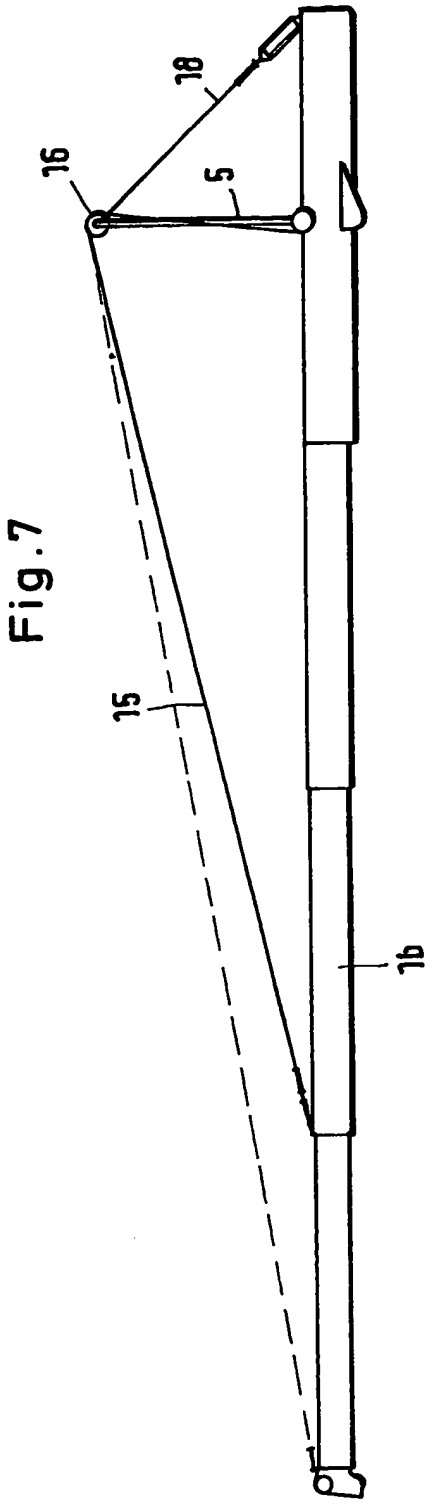

Fig.7

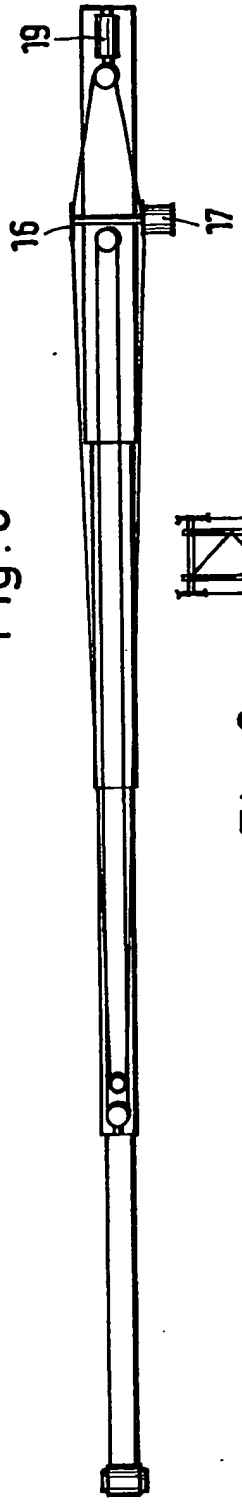

Fig.8

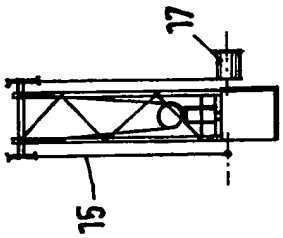

Fig.9

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Fig. 10

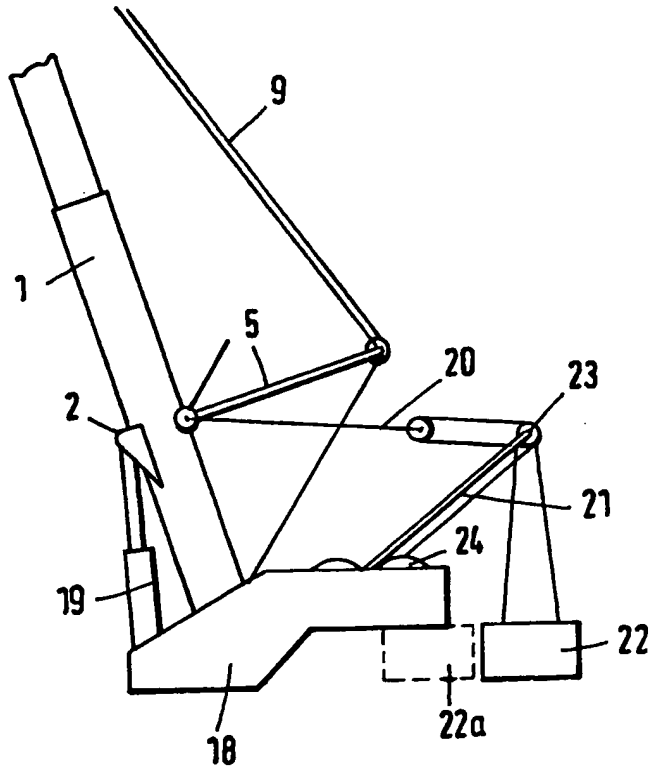
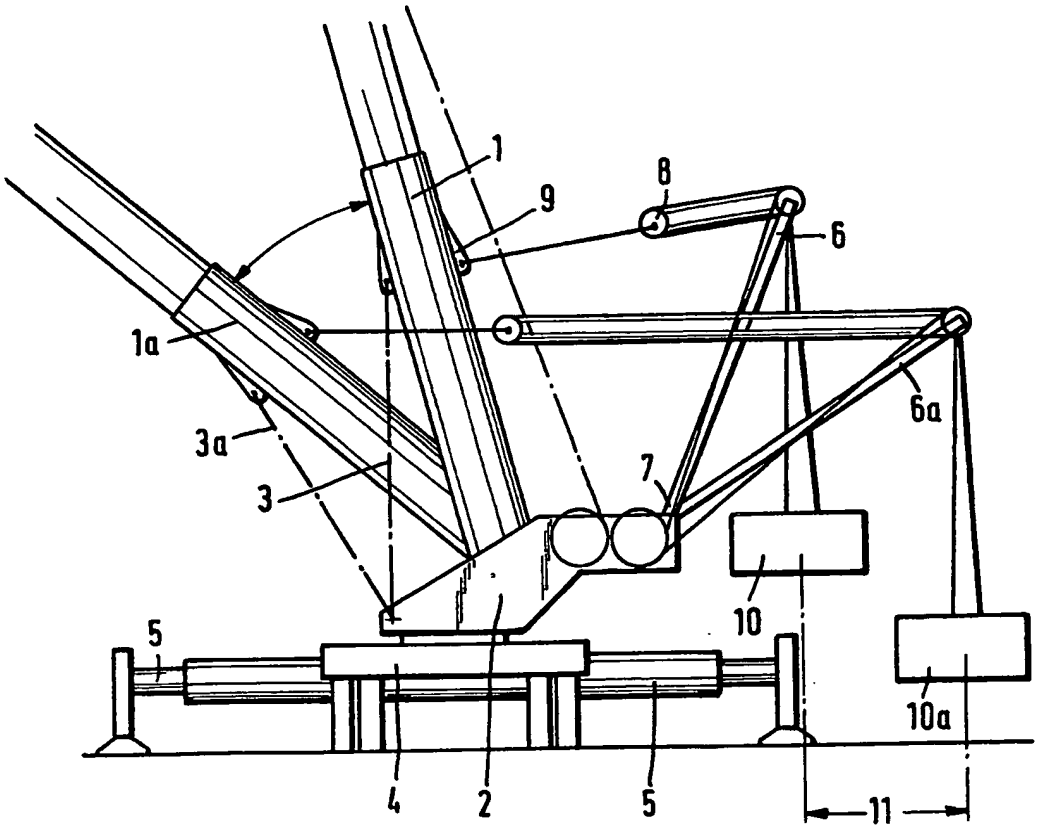


FIG 11



SPECIFICATION

Telescopic jib cranes

Mobile telescopic jib cranes are known. Such a crane may include a lower, wheeled or tracked chassis and an upper chassis which is rotatable relative to the lower chassis about a vertical axis. The jib includes a plurality of interengaging tubular sections through which passes a ram used to extend and retract the jib. The foot end of the outer section, which is that nearer or nearest to the upper chassis when the jib has been raised, and is referred to herein as the bottom section, is pivoted to the upper chassis about a horizontal axis passing through the foot end of that section, so that the jib may be raised and lowered in a vertical plane. One or more luffing rams connected between the upper chassis and the bottom section at positions spaced from the horizontal axis may be used to raise and lower the jib. Thus, by pressurising the luffing ram or rams and the extending ram, the jib may be set to a desired angle and length. Depending upon the length of the jib and the angle to which it is raised, the jib is subjected to bending forces tending to deform it, and the chassis is subjected to tilting forces tending to overturn it. To counteract this tendency of the jib to deform both under its own weight and that of the load applied to it, it has been usual to make the jib as rigid as possible. This has led to the jib being relatively heavy, which in turn impairs the mobility of the crane since it may in consequence exceed the weight limit for travel on public roads.

To overcome this problem, it is proposed herein that a frame should extend upwardly from the bottom section and be linked as by cabling firstly with the foot end of the jib and secondly with an extensible section of the jib. Because the bending stresses act between the free end of the jib and the point of connection of the luffing ram or rams to the bottom section, it is preferred for this frame to be located substantially in the same plane as that in which lie the axes of articulation to the section of the luffing ram or rams. More preferably, in order to achieve favourable force distribution in the bottom jib section, the frame extends perpendicularly to this section. By running cabling from the free end of the frame both to a further telescopic section and to the foot of the jib, a simple guying or bracing of the jib is obtained which counteracts the tendency of the jib to deform. An increase in load bearing capacity is thus obtained for the same weight of jib.

The cabling extending to the extensible jib section may pass over the free end of the frame which may be provided with pulleys or sheaves to conduct the cabling to one or more winches, preferably arranged where the frame is fixed to the bottom jib section. The frame may consist of struts which extend upwards, one on each side of the bottom section, the struts being rigidly interconnected so as to form a lattice-like structure. By providing for the cabling to follow at least two laterally spaced paths from the frame, lateral deformations of the jib in response to wind forces or oscillations of the load may be counteracted. Preferably, two separate cables are conducted between the extensible section and the free end of the frame over the sheaves, each such cable being connected to a respective winch. Likewise, the connection between the frame and the foot end of the jib may consist of two laterally spaced cables of fixed length. By operating the winch or winches as the jib is extended or retracted, the tension in the cabling may be kept substantially constant throughout. Although the frame may be linked to the foot end of the jib by cables of substantially fixed length, use is preferably made of a variable length means, such as one or more hydraulic piston and cylinder units. Such units may be used in conjunction with cabling. By using such unit or units to brace the frame against the foot end of the bottom section, increased forces may be applied because such units are capable of accepting larger forces than a winch. In use of this embodiment, the piston and cylinder unit or units may be extended to slacken the cabling or other connection between the foot end of the jib and the frame, the jib extended to its desired operating length with the winches turning to pay out the cable running to the extensible section, the winch or winches locked in position when the jib has been fully extended, and the piston and cylinder unit or units retracted to pull the frame backwards and tension the cabling extending to the extensible section. To facilitate operation in this manner, the frame may be articulated to the bottom section for movement about a transverse horizontal axis. The frame may be arranged to fold into a position lying against the bottom section during transportation of the crane.

One or more control devices may be provided for the winch or winches and/or the piston and cylinder unit or units to enable a predetermined tension to be applied to the cabling. In this way, the sum of all the forces acting on the jib may be regulated. Preferably, the forces applied by the winch or winches and/or the piston and cylinder unit or units are automatically regulated or controlled as a function of any of a number of parameters, including the length of the jib, the loading applied to it, and its angle of inclination.

The measures discussed above provide for an increase in the lifting capacity of the crane. As a result, there may be some loss of overall stability. Accordingly, it is desirable to provide means for increasing such stability. This may be achieved by increasing the mass of the

counterweight normally provided on or in association with the upper chassis or jib, but also by arranging the counterweight at a greater distance from the axis about which the upper chassis tends to tip. Accordingly, the counterweight may be supported by a mast extending upwards from the upper chassis in the direction opposite to that in which the jib extends. Conveniently, a system is provided for adjusting the inclination of the mast to maintain the counterweight at a fixed distance from the axis of rotation of the upper chassis. Alterntively, to take account of the changes in the moment acting on the upper chassis as the jib is raised or lowered, the arrangement may be such that the position of the counterweight relative to the upper chassis is varied in the sense of compensating for these changes, again by adjusting the inclination of the mast.

In the drawings:

Figure 1 is a side view of a first embodiment of jib,

Figure 2 is a plan view of the jib shown in Fig. 1,

Figure 3 is an end view looking from the foot end of the jib,

Figure 4 is a view similar to Fig. 1 of a second embodiment of jib,

Figure 5 is a plan view of the jib shown in Fig. 4,

Figure 6 is an end view of the jib shown in Figs. 4 and 5 looking from the foot end,

Figure 7 is a view similar to Fig. 1 but of a third embodiment of jib,

Figure 8 is a plan view of the jib shown in Fig. 7,

Figure 9 is an end view of the jib shown in Figs. 7 and 8 looking from the foot end,

Figure 10 is a side view of the jib and counterweight arrangement mounted on the upper chassis, and

Figure 11 is a view similar to Fig. 10 but also showing the lower chassis and illustrating one mode of adjustment of the counterweight which may take place as the jib is raised and lowered.

Referring to the drawings, in particular Figs. 10 and 11, a mobile telescopic jib crane comprises an upper chassis 18 which is rotatable about a vertical axis upon a wheeled lower chassis 25. The upper chassis supports a telescopic jib assembled from a plurality of hollow, tubular box-like sections. The foot end of the outermost section 1 (the bottom section) is pivoted to the upper chassis about a horizontal axis so that the jib may be moved in a vertical plane. Outriggers 26 may be extended from the lower chassis in order to increase stability of the crane as a whole.

The telescopic jib is movable in the vertical plane by means of one or more luffing rams 19. The cylinder of the or each such ram is articulated to the upper chassis and its piston rod articulated to a bracket 2 fixed to the bottom jib section 1. Also carried by this section is a guying frame 5 from which cabling extends to the foot end of the bottom jib section and to an extensible section, as will now be described. The frame 5 extends substantially perpendicularly to the section 1 and is located in the transverse plane thereto, which includes the axis of articulation of the piston rod of the or each luffing ram. The frame is articulated to the section about a horizontal axis to allow it to adjust in position and be lowered into a stowed position in which it rests against the section 1 of the jib to facilitate transportation.

Referring now to Figs. 1 to 3, wherein is shown the telescopic jib of a first embodiment, the jib further comprises three extensible sections marked 1a, 1b and 1c. The section 1a is telescopically receivable within the bottom section 1, the section 1b within the section 1a and the section 1c within the section 1b. A hydraulic ram extending within the section between the innermost and outermost sections is used to extend and retract the jib. The frame 5 consists of two struts 8a and 8b articulated to the section 1 about a horizontal axis at 4 and rigidly connected to each other by cross-pieces so as to form a lattice-work. Two laterally spaced cables 7 of fixed length connect the upper end of the frame 5 to points 6 at the foot end of the section 1 in order to brace the frame. Within the scope of the present proposal, the cables 7 may be replaced by struts capable of being disconnected from the frame to enable it to be stowed as described above. Mounted on the bottom section 1 in line with the frame 5 are two winches 12a, 12b, one on each side of the section. Extending from the winches are cables 9a, 9b, respectively, which pass over sheaves 11a, 11b at the upper end of the frame 5, around sheaves 10a, 10b at the end of the section 1b remote from the foot end of the jib, and back to the top end of the frame 5 to which they are secured. Instead of the cable being taken around sheaves on the section 1b, they may pass around sheaves on the section 1c as shown in broken lines in Fig. 1. By operating the winches at a suitable speed as the telescopic tube is extended or retracted, the cables 9a and 9b may be paid out or drawn in so as to maintain the tension in them substantially constant or as may be required, thereby to counteract deformations of the jib taking place under its own weight or under the load applied to it. Following setting of the jib to the required length, the winches 12a, 12b may be locked in a force-transmitting or form-fitting manner by appropriate mechanisms. This arrangement may be used especially when small guying forces are required. By providing two independent systems comprising two winches 12a, 12b, and a control unit not shown, different forces may be applied by the two winches so as to

provide a degree of stabilisation in the direction of the jib in addition to stabilisation in the vertical direction.

The embodiment shown in Fig. 4 to 6 corresponds to that just described, except that the cables 7 for bracing the guying frame are connected to hydraulic piston and cylinder units 14a, 14b respectively, articulated to the foot end of the section 1. Again, the cables may be replaced by rigid ties or the piston and cylinder units may be used to connect the frame and foot without the use of cables. The piston and cylinder units allow the overally length of the connection between the frame 5 and the foot end of the jib to be varied, thereby to adjust the tension in this connection. With this arrangement, following extension of the telescopic jib, the winches may be stopped and locked in position, and the final tension in the cabling set using the units 41a and 14b. This embodiment also permits stabilising the jib both in the loading and transverse directions. The piston and cylinder units 14 and the mechanism for locking the winches permit greater forces to be applied than are possible with the embodiment previously described.

In the embodiment shown in Figs. 7 to 9, the guying frame is braced relative to the foot end of the jib by means of a cable 18 connected at its ends to the frame 5 and passed around a sheave carried by a hydraulic piston and cylinder unit 19 articulated to the foot end of the section 1. In a modification, the cable may be passed several times around this sheave and around sheaves carried by the frame 5. The connection between the frame 5 and the section 1b is made by a cable 15 passing from a winch 17 in the region of the lower end of the frame, about a sheave 16 at the upper end of the frame, and reaved twice about the sheaves on the section 1 and a sheave at the upper end of the frame 5, before being connected to the frame. As with the previous embodiments, the winch may be locked in force-transmitting and form-fitting manner by a suitable device. This embodiment does not permit active transverse stabilisation of the jib, although a passive transverse stabilisation is possible if the height to width ratio of the jib is suitably selected. The arrangement whereby the cable 18 is passed around a sheave carried by the piston and cylinder unit 19 allows uniform distribution of the tension between the runs of the cable 15. The arrangement whereby the runs of this cable pass around a plurality of sheaves enables a single winch 17 to be employed.

Referring again to Fig. 10, it will be seen that a mast 21 is pivoted to the upper chassis for movement in the same vertical plane as the telescopic jib. A counterweight 22 is suspended from the mast which is supported from the jib by a connection of variable length including sheaves 23 on the end of the mast 21, a sheave supported by a cable 20 of fixed length connected to the jib at or near the point of connection of the frame 5, and a cable passing around the two sheaves and connected to the mast and capable of being drawn in and paid out by a winch 24. By appropriately controlling the operation of the winch 24, the counterweight 22 may be maintained at a constant distance from the vertical axis of rotation of the upper chassis as the jib is luffed up or down. The counterweight 22 may be replaced or supplemented by a DIN weight 22a. This weight is arranged to be movable along the chassis by the mast 21 to different positions.

Fig. 11 shows how the counterweight may be moved so as to vary its distance from the axis of rotation of the upper chassis as the jib is raised and lowered in order to increase the moment applied by the counterweight to the upper chassis as the moment imparted thereto by the jib increases, and vice versa. In this way, the moment applied by the jib may be balanced in whole or in part. Adjustment of the counterweight is carried out by operating the winch 24 in response to devices which are sensitive to the angle of inclination of the jib, and the distance between the counterweight and the axis of rotation. A comparison between the two values is made and if the angle of the jib is now varied, the winch is operated to swing the mast so as to increase or reduce the distance of the counterweight from the axis of rotation of the upper chass as may be required.

CLAIMS

1. A vehicle mounted crane having a telescopic jib pivotal in a vertical plane about a horizontal axis, the jib including a plurality of telescopic sections, ram means connected between a chassis of the crane and a bottom one of the sections, a frame extending upwardly from this section, said frame being connected by cabling with an extensible telescopic section of the jib, and with the foot end of the jib.

2. A crane according to claim 1, wherein said frame extends substantially perpendicularly to the bottom section.

3. A crane according to claim 1 or claim 2, including devices for adjusting tension in the cabling.

4. A crane according to any preceding claim, wherein the frame is provided at or near its free end with pulleys for cabling extending to the extensible telescopic section, and wherein said device includes at least one winch for winding in and paying out said cabling.

5. A crane according to claim 4, wherein the or each winch is capable of being locked in position.

6. A crane according to any preceding claim, wherein the frame is connected with

the foot end of the bottom section by cabling or other means of substantially fixed length.

7. A crane according to any of claims 1 to 5, wherein devices for adjusting tension in the cabling includes at least one piston and cylinder unit connected between the frame and the foot end of the bottom section.

8. A crane according to any preceding claim, including a control means for the device or devices for adjusting the tension in the cabling.

9. A crane according to claim 8, wherein the tension forces applied by said device or devices are automatically regulated or controlled as a function of one or more of the length of the jib, the loading thereon, or the angle of the jib relative to the horizontal.

10. A crane according to any preceding claim, wherein the frame comprises rigidly interconnected spaced-apart struts, each strut extending upwarly from a respective side of the bottom jib section.

11. A crane according to any preceding claim, wherein the frame is foldable into a transport position extending longitudinally of the bottom jib section.

12. A crane having a telescopic jib pivotal in a vertical plane about a horizontal axis, the jib including a plurality of telescopic sections, ram means extending between a chassis of the crane and a bottom jib section, a frame extending upwardly from this section, said frame being connected with the foot end of the jib and with an extensible telescopic section of the jib, and a mast extending upwardly from the chassis in a direction opposite to that in which the jib extends, the mast supporting a counterweight, and being adjustable in inclination.

13. A crane according to claim 12, including a connection between the mast and the bottom jib section, and means for varying the length of said connection.

14. A claim according to claim 13, wherein said connection is provided by cabling and a winch is provided for adjusting the length of said cabling, the winch being so controlled that the counterweight is maintained at a fixed position relative to the chassis during luffing of the jib.

15. A crane according to claim 13, wherein said connection is constituted by cabling, and a winch is provided for adjusting the length of said cabling, said winch being so controlled that the position of the counterweight is adjusted as a function of variations in position of the centre of gravity of the device as a consequence of luffing of the jib.

16. A crane as claimed in claim 1 or claim 12, substantially as hereinbefore described with reference to and as illustrated in any of the Figures of the drawings.

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